Journal of Theoretical and Applied Information Technology
30th September 2014. Vol. 67 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

TRACKING MANUALLY SELECTED OBJECT IN VIDEOS USING COLOR HISTOGRAM MATCHING

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ABSTRACT

Tracking a moving object over time is a challenging task. In this paper object to be tracked is manually selected by the user in one video frame and it is tracked in all subsequent frames of the given input video sequence. The work is carried out in two steps. First the object is detected using 64bin colour histogram matching and the object positions in all the video frames is determined to obtain a temporal sequence of coordinates. Next the object is tracked by calculating Euclidean distance between tracked objects and manually selected reference object. The proposed method is compared with KLT tracker which is a kernel based tracking method and it is found that 64 bin colour histogram matching method can be used to track objects effectively. The results show that the colour histogram features are very efficient in tracking objects, in small and medium length video sequences.

Keywords: *Object selection, histogram features, histogram matching, object tracking*

1. INTRODUCTION

Manual detection and tracking of object(s) is a tedious and time consuming task. The object detection process affects the subsequent object tracking [1] and so accurate detection of object in all the video frames is an important criterion for efficient tracking of the object in a video. Semi-automatic and automatic object detection and tracking techniques have been proposed by researchers in the literature. These detection and tracking techniques are based on maintaining a model, which is related to the spatial relationship between the various features such as color, shape, texture, contours and motion etc. [2][3]. In this work color features are used to detect and track moving object in small and medium video sequences.

Object Detection

Video segmentation methods can be classified as spatial and temporal segmentation methods. In this work semi-automatic image segmentation using spatial approach is carried out. Here the given video sequence is converted to frames and 64 bin color histogram is used to segment the object to be tracked in the remaining frames. Semi-automatic image segmentation involves end-user interactions to separate the interested object(s) from background [1]. In the proposed work the user manually selects the object to be tracked and that object is automatically tracked in the subsequent frames and thus making the approach semi-automatic.

Object Tracking

Tracking of a moving object over time is a challenging issue in video processing. Tracking involves detecting the position of an object in each image (i.e., video frame) to determine the temporal sequence of coordinates [4]. Simply by concatenating the positions of the given object in each frame the object can be tracked. The points in a coordinate system that are travelled by an object in a time scale are considered as the trajectory of this moving object. The states of the objects are stored in states vector, where n dimensional state vector where each dimension gives the value of parameters such as position, velocity, acceleration, size, shape, color, texture at an instant [4]. The proposed method use color histograms to track moving object(s). The approache is based on the color probability distribution or color-clustering often with dynamical changes of color probability distribution (CPD). Intensity histogram is one of

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

the simplest approaches for representing object appearance and it is used in tracking algorithms. A number of works based on histogram tracking could be seen in literature. Integral images and integral histogram has been used in the works of [1] and [2], for detecting and tracking rectangular shaped objects. Elliptical or circular kernels are employed for defining regions around the target from which weighted histograms are computed. This is done to deal with shape variations when histograms are used in object tracking in [3] and [4]. In [5] differential algorithms are designed to iteratively converge to the target object. Yet another approach to track irregular shaped object is to enclose the object in a rectangular area bounding the object and to compute histogram from the bounded region [6]. In this work in order to track colored object(s) in the given video sequence, the color image data has to be represented as a probability distribution [1]. This kind of object detection and tracking process has lower computation cost than the approaches based on graph-cut or active contour models as well. In this paper, 64 bin histogram matching algorithm is used for detecting as well as tracking in a video. The work is done in two steps (i) Detecting and (ii) Tracking. The video is first converted to frames and the first frame is assigned to be the reference frame. The user selects the desired region in the reference frame and that region becomes reference object and it is tracked in succeeding frames using histogram matching technique and without user interruption. The tracked object in the next frame then becomes the new reference frame and the process is repeated until the object is tracked in all the frames of the video. Thus the target region frame dynamically changes without user intervention.Histogram based tracking is useful in cases where there is no much shape variation such as face tracking. In this work the object to be tracked is bounded inside a rectangle and 64 color histogram features are extracted from that region. Histogram matching using Euclidean distance is carried out to track the object of interest in subsequent video frames. Also a comparison of the proposed work is made with another semi-automatic tracker namely KLT tracker. KLT tracker is a simple and efficient point tracker. The point tracker tracks a set of points using the Kanade-Lucas-Tomasi (KLT), feature-tracking algorithm. The tracker is based on the early work of Lucas and Kanade [5], was developed fully by Tomasi and Kanade [6]. The minimum Eigen value of 2X2 gradient matrix is analysed by KLT to obtain good features. Then 'Newton Raphson method' is used to track the features by minimizing the difference between the windows. This paper is organized as follows. Literature review is done in section II. Section III gives the methodology of the proposed work, the results and discussion are given in Section IV and Section V concludes the paper.

2. LITERATURE REVIEW

Variants of the background subtraction (BS) methods used in detecting objects in video sequences are covered in detail in the survey paper [7]. Background subtraction methods are based on using a single reference image corresponding to an empty scene as the background model [8]. This is a simple technique and is not suitable for complex surveillance systems. Mean-shift segmentation is a non-parametric technique which analyses complex multi-modal feature space and helps in identification of feature clusters [9]. The MS algorithm is initialized with a large number of randomly chosen centres of the given video frame. The new cluster centroids are estimated iteratively. The algorithm builds up a mean shift vector, which is defined by the old and the new cluster centres computed iteratively until the cluster centres do not change their positions [10]. CAM Shift (CMS) tracking is the variation of MS tracking method. While the latter operates on colour probability distributions (CPDs), and former is a varied form of MS to deal with dynamical changes of CPDs [11] [12]. An optical flow (OF) method tracks a region defined by a primitive shape, whose translation is computed using a differential method. The principle used in OF method is that the brightness is continuous for most of the points in the image in subsequent frames and neighbouring points also have approximately the same brightness [7]. KLT tracker's by computing the object translation between frames using differential method. Propagated unreliable points are discarded and replaced with new points, and the output of algorithm is a set of these reliable points [5]. Intensity histogram is one of the simplest approaches for representing object appearance and it is used in tracking algorithms. A number of works based on histogram tracking could be seen in literature. Integral images and integral histogram has been used in the works of [13] and [14], for detecting and tracking rectangular shaped objects. Elliptical or circular kernels are employed for defining regions around the target from which

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weighted histograms are computed. This is done to deal with shape variations when histograms are used in object tracking in [14] and [15]. For tracking irregular shaped object the object is enclosed in a rectangular area bounding the object and then histogram is computed from the bounded region in [16]. Histogram based tracking is useful in cases where there is no much shape variation such as face tracking. In this work the object to be tracked is bounded inside a rectangle and 64 colour histogram features are extracted from that region. Histogram matching using Euclidean distance is carried out to track the object of interest in subsequent video frames. Usage of active contour models (ACMs) in video object segmentation and tracking is found in [17], where a snake model's control points are taken as global descriptors describing the global shape of object of interest. Review and Evaluation of various methods for moving Object Detection and Tracking is done in [18].

3. METHODOLOGY AND RESULTS

The proposed work is carried out using sample video sequences from PETS 2001 database. The work is done in two stages (i) Detection and (ii) Tracking. The overall block diagram is shown in Fig. 1.

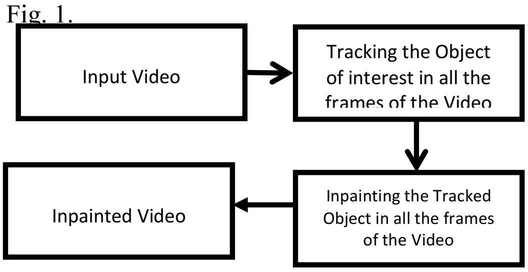

Fig. 1 Overall Block diagram of the proposed work

The overall block diagram is shown in Fig. 1.

The proposed detection and tracking algorithm is given in the following steps:

1. Input video is converted to frames and it is shown in Fig. 3a.
   The first frame is chosen as the reference frame where the object to be tracked is manually selected as a rectangle as shown in Fig. 3b. This is taken as the reference block R_b.64 bin colour histogram features are extracted from the manually selected rectangular block R_b.

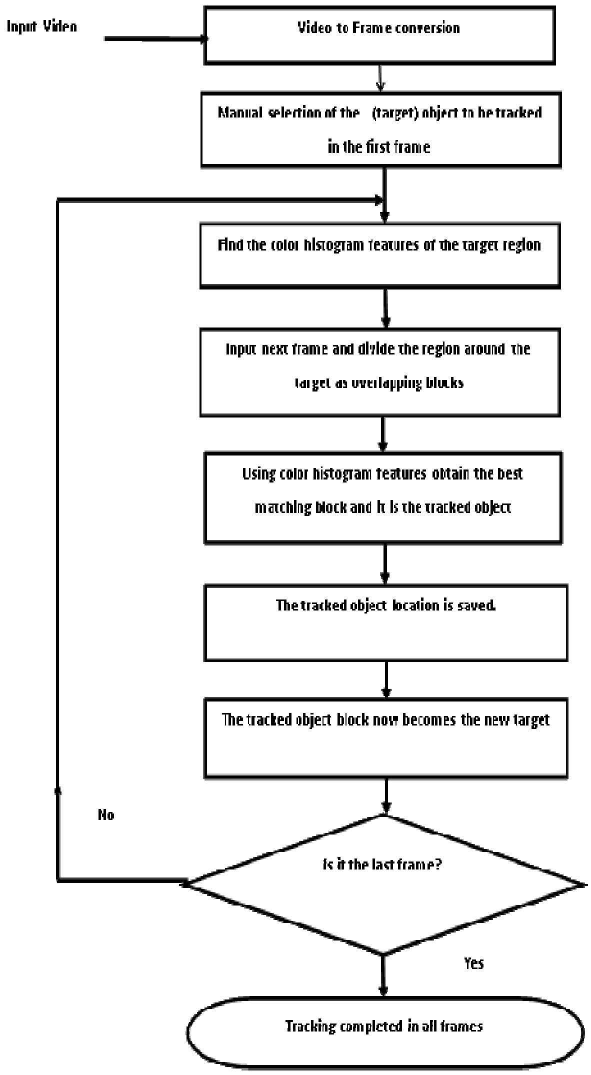

Fig. 2 Block diagram of the proposed Tracking Algorithm

2. The neighbouring region around R_b is divided into overlapping blocks in the next frame and the block size is chosen to be that of size of R_b. are compared with the histogram of R_b. Euclidean distance [13] is used to find the minimum distance block and that block which has the minimum distance is chosen as the new reference block R_b in that frame and it represents the tracked object.
3. Steps 4 and 5 are repeated until all the frames are tracked.

The block diagram for proposed detection and tracking algorithm is given in Fig. 2

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30th September 2014. Vol. 67 No.3

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

4. RESULTS AND DISCUSSION

To evaluate the performance of proposed work, the experiments, were performed on videos taken from CAVIAR, BoBoT and PETS2001. In this work a comparison is made between the proposed color histogram based tracker with the Kanade-Lucas-Tomasi Feature tracker [15]. Fig. 3 and Fig. 4 show the tracking results using the proposed histogram matching technique KLT tracker where a man is tracked. Both the algorithms were able to track the man in all the frames. Fig. 5 and Fig. 6 shows another video where the object to be tracked is crossed by similar and nearby objects. Here the histogram based algorithm performs well when compared to the KLT algorithm. This is because the KLT is a point tracker and used for short-term tracking. Due to lighting variation and out of plane rotation, points can be lost as tracking proceeds. Points have to be re-estimated periodically to track an object over a long period of time.

Fig. 3 (a). Original frame, (b) manually selected object (man) to be tracked, (c), (d), (e) Object tracked in subsequent frames using KLT algorithm

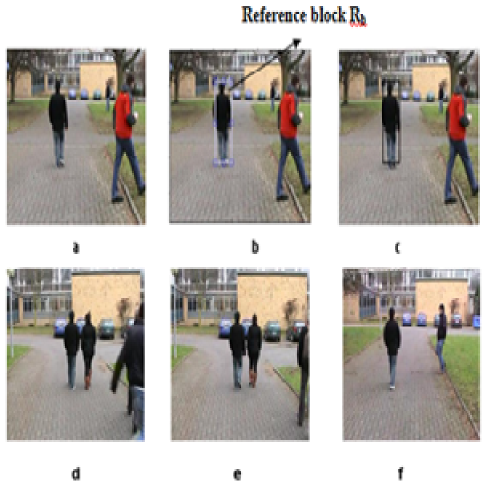

Fig. 4 (a). Original frame, (b) Manually selected object (man) to be tracked, (c), (d), (e) Object tracked in subsequent frames using proposed histogram matching

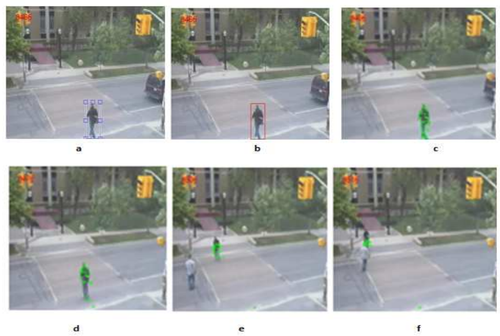

Fig. 5 (a). Original frame, (b) Manually selected object (man) to be tracked, (c), (d), (e) Object tracked in subsequent frames using KLT algorithm.

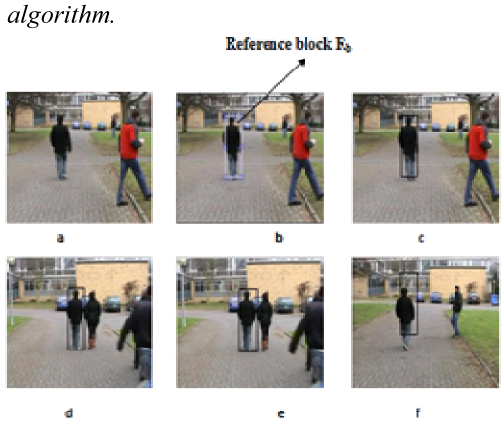

Fig. 6 (a). Original frame, (b) Manually selected object (man) to be tracked, (c), (d), (e) Object

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

tracked in subsequent frames using proposed histogram matching

KLT works well only while tracking objects that do not change shape and for those that exhibit visual texture. But since our algorithm is based on color features even though the object to be tracked is crossed by similar objects and other objects are present nearby, it is able to track the objects accurately

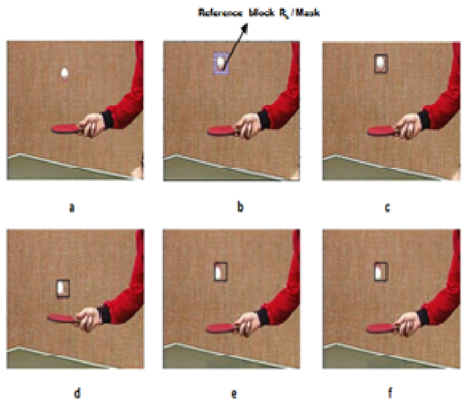

Fig. 7 (a). original frame, (b) manually selected object (ball) to be tracked, (c) object tracked in subsequent frame using KLT algorithm (d), (e) object not tracked in succeeding frames using KLT algorithm.

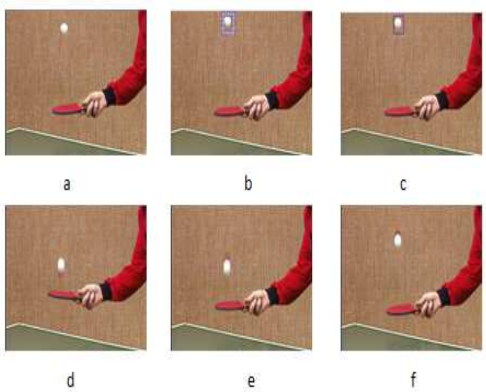

Fig. 8 (a). Original frame, (b) Manually selected object (ball) to be tracked, (c), (d), (e) Object tracked in subsequent frames using proposed histogram matching

But the KLT tracker failed in tracking the ball. This is because as the point tracker algorithm progresses over time, points can be lost due to articulated motion. Hence it becomes difficult to reacquire the points periodically and thus KLT was not successful in tracking the ball.

Performance Evaluation

The efficiency of the tracking algorithm is evaluated using the metric False Detection Rate as it provides a measure which characterizes the reliability of tracking.A qualitative comparison is made between proposed method and the KLT tracker. For these two methods, three experiments are conducted to evaluate the performance of the proposed method. The tracking performance scores are listed in Table 1, where miss denotes the number of frames tracked incorrectly and total represents the total frames in an image sequence

Table 1 Performance Analysis Of Two Trackers

Tracker	Waking man Miss/ total	Man crossing Miss/ total	Tennis Sequence Miss/ total
KLT tracker	21/121	35/164	25/35
Proposed tracker	13/121	17/164	06/35

For the walking man video taken from CAVIAR database, 121 sample frames are taken for experiment, in which it was found that number of wrongly tracked objects using KLT tracker is more than that of the proposed tracker. In another video taken from BoBoT database, the KLT tracker's false detection rate is more than our proposed tracker, because KLT tracker detects perfectly only if the shape is fixed and it should not be occluded by other objects. In the tennis sequences, taken from PETS 2001 database FDR of the KLT tracker is more than that of the proposed tracker due to articulated rotation. The graph in Fig. 9 shows the comparison of KLT tracker and the proposed histogram based tracker with respect to False Detection Rate (FDR). It could be seen that the proposed algorithm gives better performance for all the three video taken up for the study.

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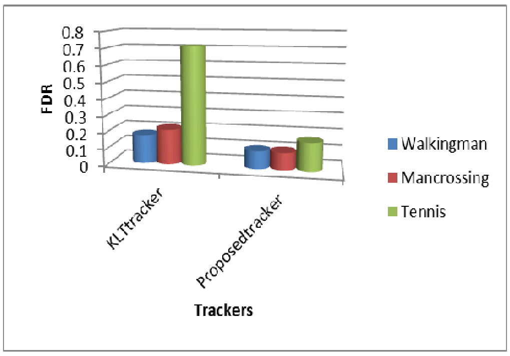

Fig. 9. Comparative Analysis Of Proposed Method With KLT Tracker Method

5. CONCLUSION

This paper deals with automatic tracking of object in short and medium colour video sequences. First the reference frame is taken and the object which is to be tracked is selected manually. 64-bin colour histogram features are obtained from this reference object. For detection and tracking of the chosen object in subsequent frames colour histograms features are extracted from each neighbouring overlapping blocks in the subsequent frame and the histogram of these overlapping blocks are compared with the histogram of the reference object and Euclidean distance matching is used to detect the object and the spatial coordinates are saved. The process continues for all the frames and by concatenating the spatial coordinates of the object in all the frames the object is tracked in the video. The proposed work is tested with CAVIAR, BoBoT and PETS 2001 database and it works well on videos with both simple and complex backgrounds. However, when the background is quite complex and the video is too long the proposed algorithm fails to track the object accurately in some frames. Also a comparison was made with the KLT tracker algorithm and the color histogram based tracker performs very well with high detection rate. Further, the obtained results can be improved in order to reduce false negatives and positives with good temporal coherence.

REFERENCES

[1] Karasulu, Bahadir, and Serdar Korukoglu. "A Software Approach to Performance Evaluation." Performance Evaluation Software. Springer New York, 2013. 31-37.

[2] Sankaranarayanan, Aswin C., Ashok Veeraraghavan, and Rama Chellappa. "Object detection, tracking and recognition for multiple smart cameras." Proceedings of the IEEE 96.10 (2008): 1606-1624.

[3] Loza, Artur, et al. "Structural similarity-based object tracking in video sequences." Information Fusion, 2006 9th International Conference on. IEEE, 2006.

[4] Moeslund, Thomas B. Introduction to video and image processing: Building real systems and applications. Springer, 2012.

[5] Lucas, Bruce D., and Takeo Kanade. "An iterative image registration technique with an application to stereo vision." IJCAI. Vol. 81. 1981.

[6] Tomasi, Carlo, and Takeo Kanade. Detection and tracking of point features. School of Computer Science, Carnegie Mellon Univ., 1991.

[7] Yilmaz, Alper, Omar Javed, and Mubarak Shah. "Object tracking: A survey." Acm computing surveys (CSUR) 38.4 (2006):

[8] Benezeth, Yannick, et al. "Review and evaluation of commonly-implemented background subtraction algorithms." Pattern Recognition, 2008. ICPR 2008. 19th International Conference on. IEEE, 2008.

[9] Shan, Caifeng, Tieniu Tan, and Yucheng Wei. "Real-time hand tracking using a mean shift embedded particle filter." Pattern Recognition 40.7 (2007): 1958-1970.

[10] Comaniciu, Dorin, and Peter Meer. "Mean shift: A robust approach toward feature space analysis." Pattern Analysis and Machine Intelligence, IEEE Transactions on 24.5 (2002): 603-619.

[11] Bradski, Gary R. "Computer vision face tracking for use in a perceptual user interface." (1998).

[12] Francois, Alexandrer. camshift tracker design experiments with intel opencv and sai. university of southern california los angeles inst for robotics and intelligent systems, 2004.

[13] Russell, Stuart Jonathan, et al. Artificial intelligence: a modern approach. Vol. 2. Englewood Cliffs: Prentice hall, 1995.

[14] Birchfield, Stan. "Elliptical head tracking using intensity gradients and color histograms." *Computer Vision and Pattern Recognition, 1998. Proceedings. 1998 IEEE Computer Society Conference on.* IEEE, 1998.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[15] Comaniciu, Dorin, Visvanathan Ramesh, and Peter Meer. "Real-time tracking of non-rigid objects using mean shift." Computer Vision and Pattern Recognition, 2000. Proceedings. IEEE Conference on. Vol. 2. IEEE, 2000.
[16] Viola, Paul, and Michael Jones. "Rapid object detection using a boosted cascade of simple features." Computer Vision and Pattern Recognition, 2001. CVPR 2001. Proceedings of the 2001 IEEE Computer Society Conference on. Vol. 1. IEEE, 2001.
[17] Adam, Amit, Ehud Rivlin, and Ilan Shimshoni. "Robust fragments-based tracking using the integral histogram." Computer Vision and Pattern Recognition, 2006 IEEE Computer Society Conference on. Vol. 1. IEEE, 2006.
[18] Gouet-Brunet, Valérie, and Bruno Lameyre. "Object recognition and segmentation in videos by connecting heterogeneous visual features." Computer Vision and Image Understanding 111.1 (2008): 86-109.
[19] Karasulu, Bahadır. "Review and evaluation of well-known methods for moving object detection and tracking in videos." Journal of aeronautics and space technologies 4.4 (2010): 11-22.